

GINGIVITIS AND GINGIVAL HYPERPLASIA IN PATIENTS DURING THE FIXED ORTHODONTIC THERAPY – A CASE-CONTROL STUDY

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ABSTRACT

Introduction: Fixed orthodontic therapy takes an important place in dental medicine with the aim of improving the appearance of dento-facial structures, in esthetic as well as functional sense. Structural elements of fixed orthodontic apparatus, such as brackets and ligatures, represent predictive spot for plaque accumulation, which may lead to changes in the gingiva. The most common changes are gingivitis and gingival hyperplasia.

Aim: To indicate a connection between therapies by means of fixed orthodontic apparatus and inflammatory changes in the gingiva, as well as the importance of multidisciplinary collaboration between the orthodontist and the periodontist.

Material and methods: The research included 60 students from the fourth, fifth and sixth year of the Faculty of Dentistry in Sarajevo. The students were divided into two groups. The first group consisted of 30 students having the therapy by means of fixed orthodontic apparatus (group A), and the second group consisted of 30 students not having the therapy (group B). Before the examination, all subjects have read and signed information consent for voluntary participation to the research. The subjects had one medical examination and went through periodontological anamnestic diagnostic protocol.

Results: Obtained results are statistically processed and discussed together with the results of other authors.

Keywords: Fixed orthodontic therapy, gingivitis, gingival hyperplasia.

Introduction

Orthodontic therapy takes an important place in dental medicine with the aim of improving the appearance of dento-facial structures, in esthetic as well as in functional sense. One type of orthodontic therapy is fixed orthodontic therapy being widespread due to its positive effects. Oral hygiene maintenance during fixed orthodontic therapy is difficult and requires education and motivation of patients, as well as additional effort from the patient's part. Structural elements of fixed orthodontic apparatus represent a predictive spot for dental plaque retention. As a result of plaque retention changes in periodontal structures often occur and most often these changes are gingivitis and gingival hyperplasia [1].

Gingivitis represents an inflammatory state of the gingiva which is induced by bacteria. There are also other etiological factors which may lead to disease such as viruses, hormones, heredity, systemic conditions, harmful habits, and so on. Clinical signs of gingival inflammation include enlargement of gingival outlines which occurs as a result of edema or fibrosis, changes of color to red or bluish-red, bleeding after sounding and pain. Gingivitis caused by plaque is considered the most common form of periodontal disease. It starts on the edges of the gingiva and spreads *per continuitates* on the other parts of the gingiva and the periodontium [2].

Gingival hyperplasia represents an expression for a description of various forms of enlargement of the gingiva and is defined as disturbed enlargement of periodontal tissue [3, 4]. Even though it was neglected earlier, healthy gingiva is a prerequisite for the proper functioning of the entire organism. Noticeable gingival enlargement obstructs speech, masticating and eating, causes esthetic hindrance and increases the risk for the development of periodontology disease as well as systemic diseases [4]. The enlargement of the gingiva causes pain, gingival sensitivity and bleeding, pathological movement of teeth, occlusal and speech disorder. It can be the result of the functioning of different factors, such as the use of medications or genetic disorders [5-8]. The clinical appearance of gingival hyperplasia usually affects the labial surface of the gingiva of front

teeth. Clinically, it usually begins in the area of interdental papilla, which becomes enlarged and spreads laterally until joining the papilla of the adjacent tooth. If the control of oral biofilm is at a satisfactory level, the bleeding upon irritation will be minimal, and enlarged gingival tissue will be firm and in a healthy pink color. If oral hygiene is poor, inflammation will be present, and gingival tissue will be red. There is a significant positive link between incidence and/or intensity of gingival enlargement and the amount of oral biofilm and calculus that is present. The enlargement is painless and progresses slowly, and in more difficult cases it can completely cover the teeth [9-12].

Gingival enlargements are usually classified in relation to clinical appearance and etiological factors.

Inflammatory gingival enlargements – Inflammation is recognized upon clinical examination, the gingiva is red, soft, shiny and easily bleeds after irritation. Inflammation is usually caused by poor oral hygiene and accumulation of oral biofilm, and it causes reactive enlargement of gingiva (focal reactive enlargement of the gingiva, inflammatory hyperplasia or epulis).

Non-inflammatory gingival enlargements – These enlargements are darker red or purple, can be firm or soft, and sometimes they bleed more easily. Predisposing factors are numerous: poor oral hygiene, specific hormonal states (puberty, pregnancy...), nutritional deficit (scurvy), blood dyscrasia (acute leukemia, lymphoma, aplastic anemia), genetic factors (epulis or Neumann's tumor), medications (anticonvulsants, phenytoin), immunosuppressive therapy (cyclosporine A), antihypertensive blockers of calcium channels (verapamil, diltiazem, nifedipine), systemic diseases (sarcoidosis, Crohn's disease, acromegaly) [13, 14, 15].

Numerous authors have researched the connection between fixed orthodontic apparatus therapy and the appearance of pathological changes in gingiva. They also discussed the question of its effect on gingiva. In 2016, Hadeel M. et al. conducted a research on a sample of 70 subjects divided into two groups (patients wearing fixed orthodontic apparatus and patients not wearing fixed orthodontic apparatus), ageing between 18 and 30 years, and they came to the conclusion that fixed orthodontic apparatus represents predictive spot for plaque accumulation leading to the inflammation of gingiva.

They also noted that patients with fixed orthodontic apparatus should attend regular control examinations and maintain adequate oral hygiene (16). In a research conducted in 2018, Amrinder S Tuli and Nitin Bhatnagar came to the conclusion that fixed orthodontic apparatus represents interference in maintaining adequate oral hygiene which may be a primary etiological factor leading to gingival hyperplasia. They have also pointed out the necessity of having both orthodontist and periodontologist multidisciplinary cooperation and they emphasized the significance of patient's motivation and education on proper oral hygiene maintenance [17].

Research hypothesis

Fixed orthodontic apparatus therapy affects the appearance of inflammatory changes in the gingiva.

Null hypothesis

There is no statistically significant difference of inflammatory changes in the gingiva in patients with fixed orthodontic apparatus and patients without fixed orthodontic apparatus.

Materials and Methods

The research was conducted at the Faculty of Dentistry in Sarajevo.

The research was conducted in the period of from January to March 2019.

60 students participating in the research are attending IV, V and VI year of study at the Faculty of Dentistry.

All subjects are ageing between 22 and 29 years.

Students are divided into two groups.

Group I includes 30 students being in the middle of fixed orthodontic apparatus therapy.

Group II includes 30 students not undergoing orthodontic therapy.

All subjects are systemically healthy and non-smokers.

The duration of therapy is between 2 months and 5 years.

Before the examination, all subjects read and signed information consent for voluntary participation to the study.

All participants attended one examination.

All participants will be subjected to periodontological anamnestic diagnostic protocol.

Periodontological anamnestic diagnostic protocol implies determining:

- Silness and Loe plaque index (IPL) – a score of 0-3, to quantify the presence of dental biofilm.
- Silness and Loe dental calculus index (CI) – a score of, to quantify the presence of supragingival and subgingival concretions.
- Silness and Loe gingival index (GI) – a score of 0-3, to quantify the degree of inflammation and alteration of the superficial periodontium.
- Muhlemann sulcus bleeding index (SBI) – a score of 0-5, to quantify the presence and intensity of gingival sulcus bleeding stimulated by a probe.
- Gingival hyperplasia (Pitting test).

All clinically examined parameters and obtained results will be entered into the charts specially designed for this research.

Results

Group A – Case group (patients with fixed orthodontic apparatus)

Group B – Control group (patients without fixed orthodontic apparatus)

Gender structure

	Male		Female		Total
	Number	%	Number	%	
Group A	7	23,3	23	76,7	30
Group B	12	40,0	18	60,0	30
Total	19	31,7	41	68,3	60

Table 1. Shows frequency (percentage) of gender structure in both examined groups and in total.

In group A there were 23 females (76, 7%) and 7 males (23, 3%), and in group B there were 18 females (60, 0%) and 12 males (40, 0%). In both groups there were 41 females (68, 3%) and 18 males (31, 7%).

The analysis of gender distribution indicates that there is no significant difference between the groups ($\chi^2=1,926$; $df= 1$; $p=0,133$; $p>0, 05$). In both groups, subjects of female gender represented the majority with 76, 7% in the case group and 60% in the control group.

Age structure – Age average per group

	Male	Female	Total
Group A	24,57±0,53	25,25±1,42	24,03±1,38
Group B	23,87±1,52	24,06±1,39	24,55±1,50
Total	25,00±1,20	23,95±1,45	24,29±1,45

Table 2. Shows the average age values of examined patients per group and in total.

The age average is 24 (24, 29). In group A (Case group) the age average is 24 (24, 03), and in group B (Control group) the age average is 25 (24, 55).

Statistical analysis by means of Student t test indicates that there is no significant difference between the groups according to age ($p > 0,05$; $t = -1,383$; $df = 57$; $p = 0,172$)

The duration of orthodontic therapy

Duration of therapy (months)	
X	16,07
SEM of X	2,944
Median	10,00
SD	6,122
Min.	1
Max.	60

Table 3. The average duration of orthodontic therapy

Since the data exists only for the Case group, in this group the average duration of orthodontic therapy amounted to 16, 1±6, 1 months with the shortest therapy duration of 1 month and the longest duration of 60 months or 5 years.

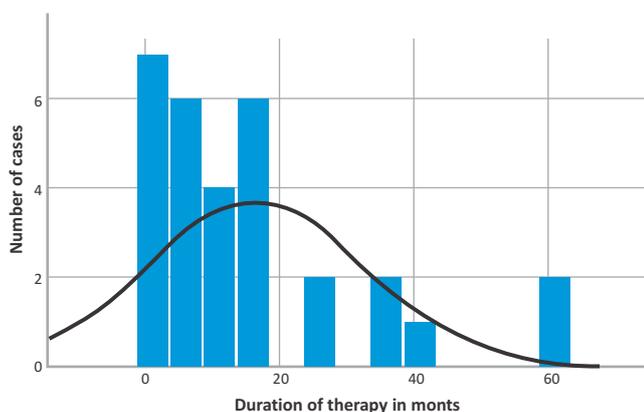


Chart 1. The average duration of orthodontic therapy

Gingivitis presence

	Gingivitis present		No gingivitis		Total
	Number	%	Number	%	
Group A	22	78,6	6	21,4	30
Group B	10	35,7	18	64,3	30
Total	32	57,1	24	42,9	60

Table 4. Shows the frequency (percentage) of the prevalence of gingivitis presence per examined group and in total

Gingivitis was considerably more present in the Case group (78, 6%) in relation to 35, 7% in the Control group. Statistical analysis indicates that there is a significant difference between the groups in relation to the presence of gingivitis ($\chi^2 = 10,500$; $df = 1$; $p = 0,001$; $p < 0,05$).

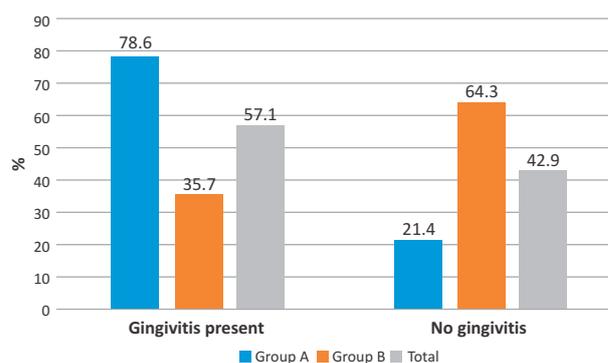


Chart 2. Presence of gingivitis per group

Also, the odds ratio analysis (odds ratio – OR) indicates that the examined patients in the case group have almost 11 times greater chance ($OR = 10,891$; $p = 0,001$) for the presence of gingivitis in relation to the examined patients in the control group.

Gingival hyperplasia presence

	Gingival hyperplasia present		No gingival hyperplasia		Total
	Number	%	Number	%	
Group A	18	66,7	9	33,3	27
Group B	3	10,3	26	89,7	29
Total	21	37,5	35	62,5	56

Table 5. Shows frequency (percentage) of the prevalence of gingival hyperplasia per examined group and in total

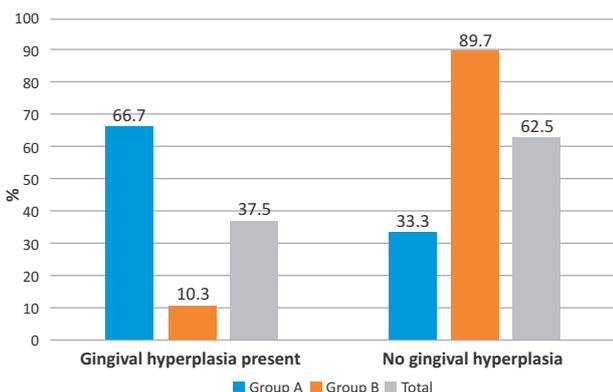


Chart 3. Gingival hyperplasia presence per group

Gingival hyperplasia was significantly more present in the Case group with 66, 7% in relation to 10,3% of the Control group subjects. Statistical analysis by means of chi-square test indicates the presence of significant difference between the groups ($\chi^2=18,924$; $df=1$; $p=0,0001$), while the OR totals 20,4, or in other words, the examined patients in the Case group have 20 times more chance for the development of gingival hyperplasia (OR=20,433; $p=0,0001$).

Plaque index

	Index 0		Index 1		Index 2	
	Number	%	Number	%	Number	%
Group A	6	20,0	23	76,7	1	3,3
Group B	4	13,3	26	86,7	0	0,0
Total	10	16,7	49	81,7	1	1,7

Table 6. Shows the frequency (percentage) of plaque index per examined group and in total

Chi-square test ($\chi^2=1,584$; $df= 2$; $p=0,453$) confirmed that there are no significant differences in

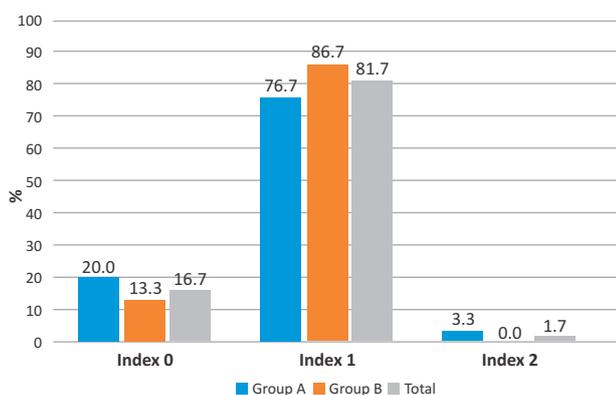


Chart 4. Representation of plaque index per group

plaque index frequencies per group. In 10 examined patients (16, 7%) index 0 was determined. In group A 6 subjects (20%) have an index 0, while in group B there are 4 (13, 3%) such cases. Index 1 is registered in 49 subjects (81, 7%) of which 23 are in group A (76, 7%) and 26 (86, 7%) in group B. Index 2 was registered only in 1 subject (1, 7%) and that is in group A (3, 3%).

Dental calculus index

	Index 0		Index 1		Index 2	
	Number	%	Number	%	Number	%
Group A	12	40,0	17	56,7	1	3,3
Group B	22	73,3	8	26,7	0	0,0
Total	34	56,7	25	41,6	1	1,7

Table 7. Shows the frequency (percentage) of dental calculus index per examined group and in total.

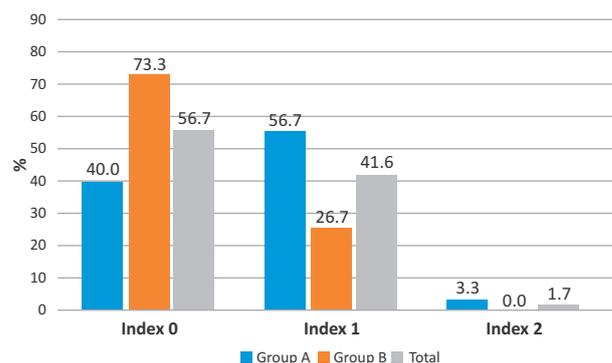


Chart 5. Representation of dental calculus index per group

Chi-square test ($\chi^2=12,441$; $df= 2$; $p=0,002$) confirmed that there are significant differences in the frequency of dental calculus index per group.

Gingival index

	Index 0		Index 1		Index 2	
	Number	%	Number	%	Number	%
Group A	3	10,0	10	33,3	17	56,7
Group B	13	43,3	14	46,7	3	10,0
Total	16	26,7	24	40,0	20	33,3

Table 8. Shows the frequency (percentage) of gingival index per examined group and in total

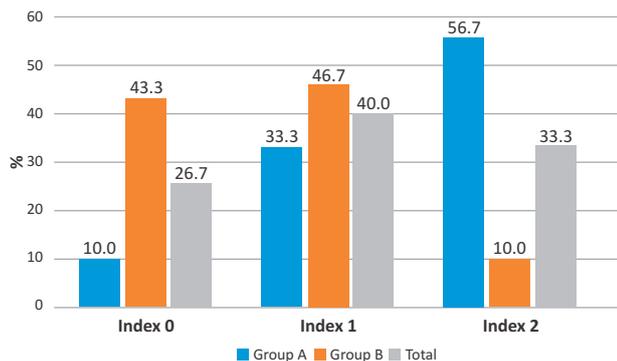


Chart 6. Representation of gingival index per group

Chi-square test ($\chi^2=16,717$; $df= 2$; $p=0, 0001$) confirmed that there are significant differences in gingival index frequency per group.

Sulcus bleeding index

	Index 0		Index 1		Index 2	
	Number	%	Number	%	Number	%
Group A	4	13,3	13	43,3	11	36,7
Group B	11	36,7	18	60,0	1	3,3
Total	15	25,0	31	51,7	12	20,0

Table 9. Shows the frequency (percentage) of sulcus bleeding index per examined group and in total.

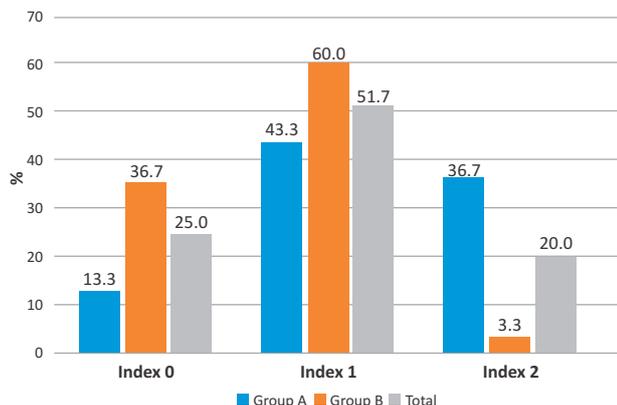


Chart 7. Representation of sulcus bleeding index per group

Chi-square test ($\chi^2=14,406$; $df= 2$; $p=0,002$) confirmed that there are significant differences in sulcus bleeding index frequencies per group.

Discussion

The results of our research showed that there is a connection between the therapy with fixed orthodontic apparatus and the changes in the gingiva manifested in the form of gingivitis and gingival hyperplasia. Gingivitis is present in 78, 6 % of examined patients that are in fixed orthodontic apparatus therapy (Case group), while the gingivitis frequency in the group of patients not being in orthodontic therapy (Control group) occurs in 35, 7 %. The presence of gingival hyperplasia in patients with fixed orthodontic apparatus therapy is 66, 7 % in relation to the patients not being in fixed orthodontic apparatus therapy. The frequency of visible plaque in subjects that wearing fixed orthodontic apparatus is 3, 3 % - a score of 2, while this frequency in subjects not being in orthodontic therapy was 0, 0 % - a score of 2. Gingival sulcus bleeding in subjects being in fixed orthodontic apparatus therapy is 36, 7 % - a score of 2, and with subjects not being in orthodontic treatment, it is 3, 3 % - a score of 2. Gingival index for subjects being in orthodontic therapy is 56, 7 % - a score of 2, and in subjects not being in orthodontic therapy, it is 10, 0 % - a score of 2.

In research conducted by Karacaoglu Fatma et al. in 2016, they examined the frequency of occurrence of gingival disease in patients with fixed orthodontic work, both adolescents and adults. The conclusion of the study showed that the average occurrence of visible plaque and gingival inflammation increases during the orthodontic treatment [18]. This corresponds to the results of our research. A study conducted by Hedeel M. et al. in 2016 aimed to carry out a comparison of the state of periodontal health in patients wearing fixed orthodontic apparatus and those that are not orthodontic patients. Attained results indicate the fact that the fixed orthodontic apparatus increases the risk of dental plaque accumulation, which may lead to gingival inflammation. Plaque index scores, gingival index scores and sulcus bleeding index scores were significantly increased within the group that was in fixed orthodontic apparatus therapy in relation to the controls [16]. We found out in our research that there are no significant differences in plaque index frequencies per group, but that there are statistically

significant differences in gingival index frequencies per group. Thus, in the case study group as high as 56,7 % of subjects has a gingival index score of 2, while in the control group only 10,0 % has the same score. Additionally, our results confirmed that there are significant differences in sulcus bleeding index frequencies per group. In the case group, 36,7 % of subjects had the sulcus bleeding index score of 2, while in the control group that score was 3,3 %.

The plaque index result that did not indicate a statistically significant difference in our research is associated with the fact that the subjects were students of the Faculty of Dentistry, and that their oral hygiene maintenance knowledge is at a higher level. It is important to note that the calculus index in our subjects indicated a statistically significant difference. Dental calculus index is increased in the case group (3,3 % - a score of 2), in relation to the control group (0 % - a score of 2). This speaks in favor of the fact that subjects in both groups have very good oral hygiene, and that the subjects with fixed orthodontic apparatus have problems with cleaning places being difficult to reach thus creating retentive spots for calculus formation.

In 2017 Alice Souza Pinto and associates published a study referring to gingival hyperplasia in orthodontic patients. The study showed that gingival hyperplasia occurs during orthodontic treatment [19]. This corresponds with our results showing that gingival hyperplasia was much more present in the case group with 66,7 % in relation to 10,3 % of subjects in the control group. In their research in 2019, Manuelli M et al. concluded that besides mechanical gingival damages in patients wearing fixed orthodontic apparatus, inflammatory changes in the gingiva are also present as a result of greater plaque accumulation, i.e. difficult oral hygiene maintenance [20]. Additionally, in 2017 Ryan K. published a study observing the effects of fixed orthodontic treatment on the gingival health and indicates that the patients in fixed orthodontic apparatus treatment have a high plaque index, as well as the gingival bleeding index [21].

The results of above-mentioned studies correlate with the results of our study – namely, that the fixed orthodontic apparatus treatment influences the development of gingival inflammation and gingival hyperplasia, with the emphasis on more difficult oral hygiene maintenance.

Conclusion

- More frequent changes in the gingiva, like gingivitis and gingival hyperplasia, are present in patients with fixed orthodontic apparatus.
- Changes in the gingiva are the result of more difficult oral hygiene maintenance due to the increased retentive surfaces.
- To accomplish success, in orthodontic as well as periodontal therapy, it is necessary to achieve good education and motivation of patients as well as oral hygiene maintenance and to emphasize the significance of multidisciplinary cooperation between the orthodontist and periodontologist.

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